

# **SPOTTED OWL MONITORING IN OLYMPIC NATIONAL PARK: 2012 ANNUAL REPORT**



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**Cover Photograph:** Nesting pair of northern spotted owls and typical habitat in the Morse Creek drainage, Olympic National Park. Photo by M. Holmgren.

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## EXECUTIVE SUMMARY

This report summarizes progress on the northern spotted owl (*Strix occidentalis caurina*) monitoring program in Olympic National Park (ONP) in 2012. Monitored spotted owl territories in the national park, together with those visited by U.S. Forest Service Pacific Northwest Research Station in the surrounding Olympic National Forest, make up the Olympic Peninsula Demographic Study Area. This is one of eight study areas called for in the Northwest Forest Plan to estimate spotted owl population trends from demographic data and monitor the effectiveness of the plan. The spotted owl territories in the NPS portion of the study have now been monitored for an average of 20.4 years.

In 2012, National Park Service personnel monitored and managed data on a sample of 52 spotted owl territories (hereafter “sites”) to determine their occupancy and reproductive status. Crews made 239 monitoring visits to spotted owl sites and 95% of visits were daytime surveys. This year 10 sites were occupied by spotted owl pairs and 13 by single spotted owls. This was the highest overall rate of site occupancy since 2006, but was made up of an unusually high number of single owls, many of which we could not relocate on subsequent visits. Seven pairs attempted to nest, fledging a total of ten young, and the average fecundity was 0.56 female offspring per adult female. We banded five new adult spotted owls and one juvenile. At sites where any spotted owls responded, they were found on an average of 49% of monitoring visits.

Data collected 1990-2008 were analyzed at a workshop in Corvallis, OR in January of 2009. This analysis estimated a range-wide rate of population decline of 2.9% a year, and a 4.3% annual decline for the Olympic Peninsula. Female fecundity appeared stable in the Olympics, but the more important estimate of adult survival was declining here and on nine of 10 other areas studied. The next meta-analysis of spotted owl demography data is scheduled for the end of the 2013 field season.

Barred owls (*Strix varia*) were first documented on the Olympic Peninsula in 1985, and competition with this species is now the primary threat to the conservation of spotted owls in protected areas. Occupancy rates of spotted owls in ONP have declined significantly following the first detection of barred owls at a site. Spotted owls which have remained on territories following detections of barred owls have both moved farther and increased in elevation relative to sites where barred owls are absent. Barred owls have now been detected within 800 meters of 88% of monitored spotted owl sites in ONP. This year we confirmed barred owl presence at 81% of monitored spotted owl sites. Although barred owls now occupy portions of most spotted owl territories here, the majority of spotted owl sightings occur greater than 800 meters from any recorded barred owl detection. Models suggest that barred owls are less likely to occupy spotted owl sites on the steepest, driest slopes, and the movement of the remaining spotted owls to steeper slopes and higher elevations is making access and complete survey more difficult at many sites.

## INTRODUCTION

Olympic National Park (ONP) is located on the Olympic Peninsula in northwest Washington State. The park consists of 922,653 acres, of which roughly 756,000 acres are forested valleys naturally fragmented by high elevation peaks and ridges. Due to the lack of historic timber harvest or recent stand-replacing natural disturbance, most of the forested landscape is dominated by stands older than 100 years. There is a marked precipitation gradient from rainforest valleys in the southwest to rainshadow areas in the northeast, resulting in two very different strata (hereafter east- and west-side). Drier, east-side forests tend to be younger and dominated by Douglas-fir (*Pseudotsuga menziesii*). West-side forests have a lower frequency of fire and contain more shade-tolerant species such as western red-cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and Pacific silver fir (*Abies amabilis*), with varying amounts of Douglas-fir.

The Olympic Peninsula Demographic Study Area consists of 54 northern spotted owl (hereafter spotted owl) territories monitored by National Park Service crews in Olympic National Park and 45 territories monitored by U.S. Forest Service Pacific Northwest Research Station (PNW) crews in the surrounding Olympic National Forest. Site selection for the ONP portion of the study was not strictly random. Initially, all known sites were monitored. As additional sites were located in the course of surveying randomly located inventory plots, these were added to the sample if they were within a one day hike of a site already being monitored. Forty percent of the current sample of sites were monitored by 1990 and no sites were added or dropped after 1996. Funding and the logistics involved in monitoring sites as far as 24 miles from a trailhead determined the total number of sites that were feasible to monitor. We have continued to monitor sites regardless of their occupancy status and have also tried to keep them well distributed throughout the park, although we monitor fewer sites on the park's west side due to the lower density of spotted owls there. This study area, including both Park and Forest Service managed lands, is generally representative of habitat conditions on federal lands on the Olympic Peninsula, although the proportion of suitable habitat in the study area is somewhat higher than outside, owing to the higher proportion of National Park land (Appendix F, Anthony et al., 2006). It is not representative of state, private and tribal lands on the Olympic Peninsula, where there is little suitable habitat and few or no remaining spotted owls.

This report summarizes results of fieldwork, cooperative efforts and administration of National Park Service run portion of Olympic Peninsula Demography Study during the 2012 breeding season. It is intended as a summary of results for administrators and cooperators, but does not present detailed methodologies or data analysis. Methods are described in Franklin et al. (1996).

Results from the PNW administered portion of the Olympic Peninsula study will be available at:

<http://www.fs.fed.us/pnw/olympia/wet/team-research/owl-res/index.shtml>

Reports from most cooperators in the Northwest Forest Plan's Northern Spotted Owl Effectiveness Monitoring Program are available at:  
<http://www.reo.gov/monitoring/reports/northern-spotted-owl-reports-publications.shtml>

## **OBJECTIVES**

The Olympic Peninsula Demography Study is one of eight areas where demographic rates are monitored to assess the effectiveness of the Northwest Forest Plan in preventing a further decline in spotted owl populations. ONP also provides a unique opportunity to understand the ecology of the northern spotted owl in a large area of suitable habitat with almost no history of timber harvest. The specific objectives of the study are to:

1) Document age-specific survival and fecundity to contribute to a range-wide assessment of spotted owl population trends, as required by the effectiveness monitoring component of the Northwest Forest Plan.

2) Monitor the effects of increasing barred owl populations on spotted owls.

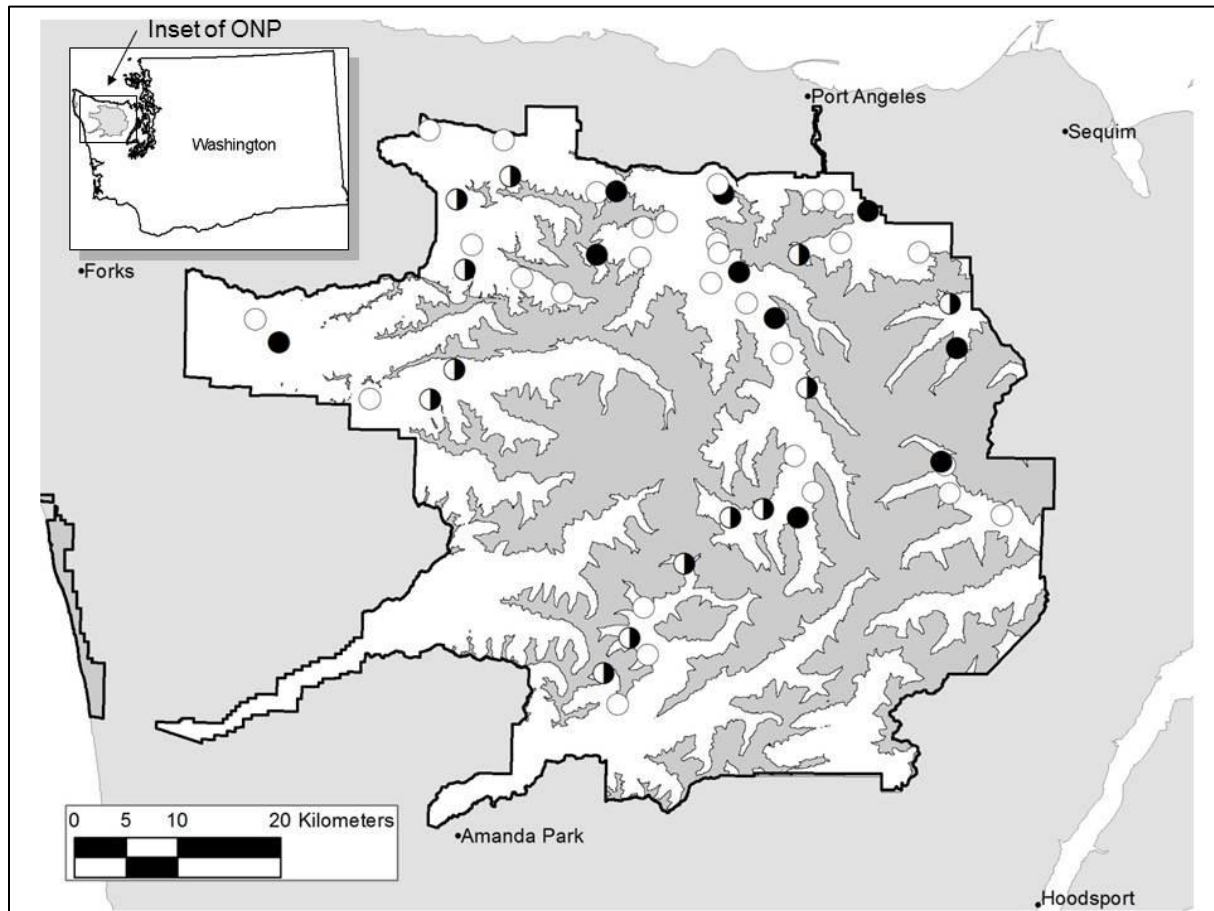
## **2012 RESULTS**

### General Monitoring and Site Status

The project employed six full-time and one half-time biological technician, one full-time intern, and the project lead. Crews made 239 visits to 54 monitored spotted owl sites (Figure 1). The mean number of visits per site was 4.4 (range 3-8). Two of these sites were formerly monitored by PNW, and they continue to manage those data. We report these site visits here, but the sample size for most analyses is 52 except where noted. Most visits (95%) were daytime searches where crews focused their efforts on recently occupied activity centers, covering suitable habitat out to 2 km as time permitted. The remaining visits were night or twilight surveys from roads or trails. The full field crew (4-5 one or two-person teams) visited owl sites between March 27 and July 10, with some additional work continuing through August.

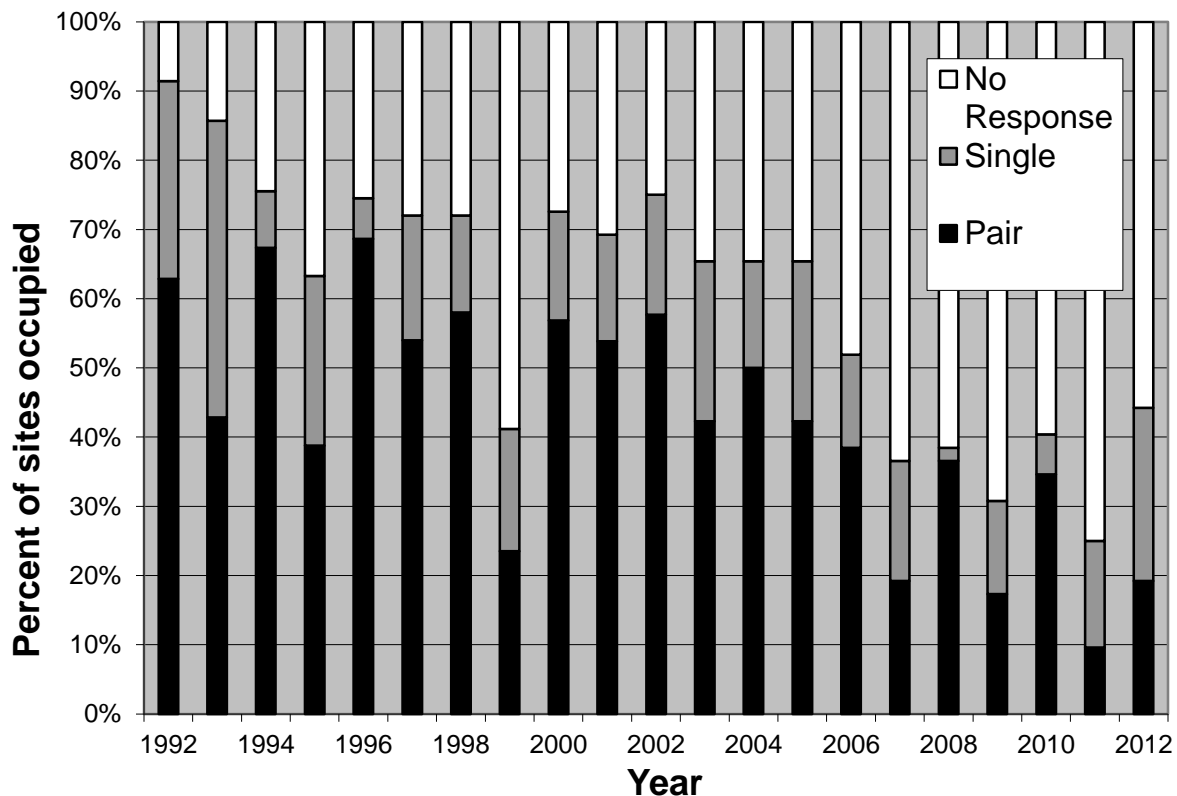
La Nina conditions once again affected the region during the winter and through the field season. Precipitation was recorded on 37% of site visits in the form of snow (7%) and rain or drizzle (30%). Following an early winter with near-normal temperatures and precipitation, March was much colder and wetter than average. Snowpack, which had also been at or below normal through the winter, increased to over 150% of average by April 1 (NRCS data), and most owl sites above 2000' elevation had enough snow to hinder access by this time. While

not as extreme as in 2011, much of the spring was cooler and wetter than average and the deeper snowpack persisted through the field season. Seven sites were not visited until May and one site was not visited until June. In addition to the weather, the only access problem was the continued closure of the Dosewallips Road, which added 5.5 miles to the approach hike at four sites.



**Figure 1. Location and occupancy status of 52 monitored spotted owl territories in Olympic National Park, 2012. Black dots are spotted owl pairs, half-filled circles are single owls and white circles are monitored sites with no response. Shaded area within the park boundary is high elevation non-habitat.**

One or more spotted owls were detected at 23 (44%) of the monitored sites and pairs were located at ten of these (Figure 2). Of the 33 spotted owls detected, 11 were female, 20 were male and 2 were of unknown sex. Of this population, 24 were adults three years of age or older, two were second year sub-adults and seven were of unknown age. Five territorial owls detected this year were of known age (range 2-18 years) as a result of initial capture as juveniles or subadults. Over the last five years, pairs were detected at least once at 25 sites and at least one spotted owl was detected at 34.



**Figure 2. Percent of monitored spotted owl sites occupied by 0, 1, or 2 adult owls, Olympic National Park, 1992-2012.**

This year was unusual for a nesting year in having more sites occupied by single owls than pairs. Many of these owls could not be relocated on follow-up visits and most were new, unmarked individuals. The per-visit detection rate at sites known to be occupied was 0.49, also typical for a non-nesting year when owls are found more frequently outside of core areas.

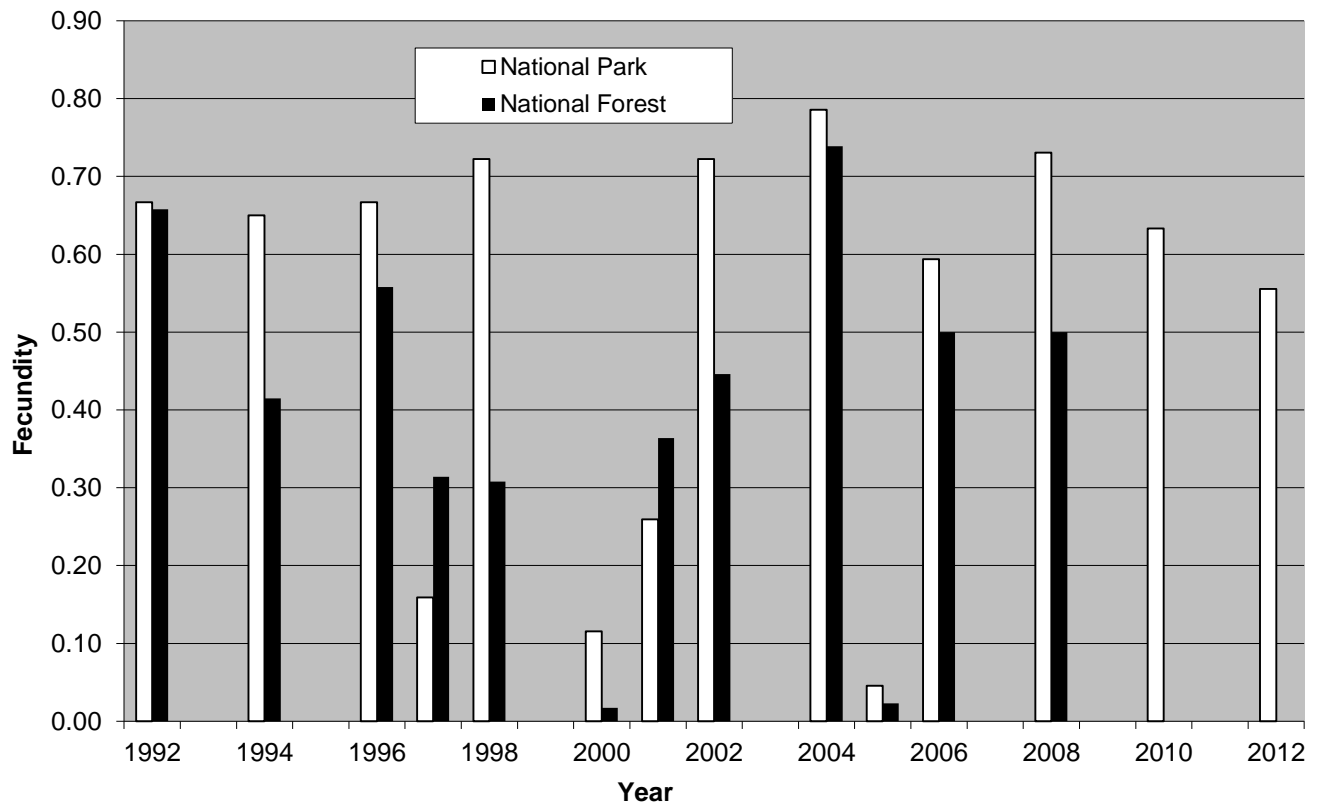
The 52 spotted owl sites monitored in 2012 represented a sample of roughly 23% of the 229 spotted owl territories estimated to occur in ONP as of 1995 (Seaman et al., 1996). The mean length of record was 20.4 years (range 17-21), not including years prior to 1992 when monitoring to current protocols began at most sites.

Since 1994, the mean elevation of occupied spotted owl activity centers has increased 443' to 2569' and the mean slope within 200 meters has increased from 24° to 32° (when calculated on the 49 sites monitored in both 1994 and 2012). These changes result from both declining occupancy at sites that are lower in elevation and less steep, and the movement of spotted owls to the steeper and higher elevation areas within monitored sites. While there is clearly a relationship between elevation and the likelihood that a spotted owl site has remained occupied, models indicate that slope and topographic moisture explain more of the variance in occupancy than elevation alone (Gremel, 2005). It is likely that these topographic variables are simply correlates for barred owl occupancy (see later section). Regardless of the factors

responsible, spotted owl distribution in the Olympics has changed dramatically over the course of this study. This has implications for both conservation efforts and our ability to monitor spotted owl sites safely and effectively.

### Nest and Reproductive Monitoring

Spotted owl productivity (fecundity) is calculated as the number of female young produced per territorial female, assuming a 50:50 sex ratio of offspring. We determined the reproductive status of 10 of 11 female spotted owls on monitored territories. Two of these did not attempt to nest and seven nested, fledging a total of ten young. None of the nest attempts failed, and both females not attempting to nest were new to the territory they occupied. One owl was found too late in the season to determine nesting status, but was confirmed to have no young. The average fecundity of adult females was 0.56 ( $N = 9$ ,  $SD = 0.390$ ). The one female of unknown age did not attempt to nest. Spotted owl fecundity in the Olympics has been highly variable, with years of high productivity often followed by years with few or no nesting attempts (Figure 3). We found no successful reproduction in seven of



**Figure 3. Olympic Peninsula adult spotted owl fecundity (mean # of female offspring/territorial female), 1992-2012. Includes both National Park (white bars) and National Forest (black bars). There were no young fledged from sites monitored in the National Forest 2009-2011, and data are not available for 2012.**

the last 21 years, including last year. The high year-to-year variation in female fecundity has been driven by the proportion of the population attempting to nest, and to a lesser extent the productivity of those nests, rather than the rate of nest success which has averaged 91% (Appendix 1). The mean annual fecundity rate for adult female spotted owls in ONP ( $N = 21$  years) was 0.35 (SE 0.071); the estimate for adult females over the range of the northern spotted owl was 0.33 (SE 0.025) (Forsman, et al., 2011).

### Banding and Capture

Banding owls is necessary to identify individuals and estimate survival rates. All captured owls are fitted with a unique U.S. Fish and Wildlife Service number band. Adult and sub-adult owls are marked with a color band unique to a 16-km radius from the capture site, which enables field crews to identify these individuals without recapturing them. Juveniles receive a standard color band, which is changed if these birds are re-captured as adults on a new territory. We use established capture techniques for spotted owls (Franklin et al., 1996), and emphasize owl safety during training.

ONP crews captured ten spotted owls in 2012. Four captures were of previously banded birds to replace lost bands (1) or to confirm the identity of the owl (3). Six captures were to band new territorial owls (5) or juveniles (1). Many juveniles fledged later than usual, and we did not make additional visits to band juveniles after meeting protocols to get an accurate count. Of the 33 spotted owls detected, we confirmed bands on 24 (73%). Among all spotted owls detected, 10 were new territorial individuals, 19 were “recaptures” based on sightings of marked owls from previous seasons and four were unknown. Since 1988, ONP crews have performed 512 captures and banded 387 spotted owls. We captured and banded under ONP master station banding permit 22633 and U.S. Fish and Wildlife Service 10(a)(1)(a) “take” permit TE842449-4.

### Juvenile Dispersal

We did not recapture any juveniles banded in previous years. Nineteen of the 172 spotted owls banded as juveniles by ONP crews prior to 2012 have been recaptured as adults or sub-adults on the Olympic Peninsula. Five dispersed to Olympic National Forest, the others were found within ONP. The median dispersal distance for this sample was 15.8 km (mean 19.1 km, SD 10.0, range 5.3-41.8 km). The mean dispersal distance of females was 44% greater than that of males, but this difference was not statistically significant. The greater dispersal distance for females is consistent with results reported by Forsman et al. (2002) for a large sample of juveniles in Washington and Oregon. The mean age at recapture was 3.2 years, implying that most spotted owls spend several years as non-territorial “floaters” or on territories outside of our study sites before being detected. To date, we have documented no dispersal of spotted owls between the Olympic Peninsula and Cascade provinces.

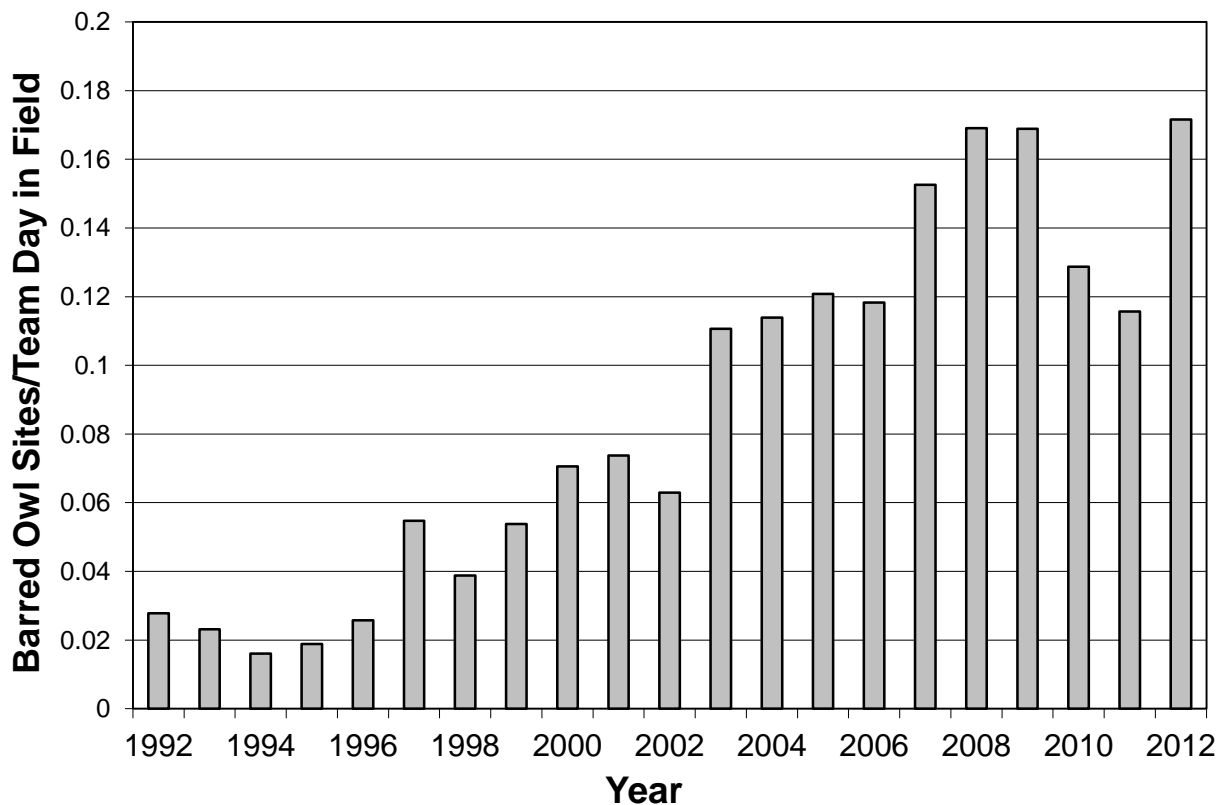
## Barred Owls and Hybrids

The first documented occurrence of barred owls on the Olympic Peninsula was on the west side of ONP in 1985 (Sharpe, 1989). This species now occurs across the entire range of the northern spotted owl and is considered to be the greatest threat to spotted owl conservation within protected reserves. Barred owls are dominant in competitive interactions with spotted owls and evidence from many areas suggests that barred owls displace spotted owls from otherwise suitable habitat (Dark et al., 1998; Hamer, 1988; Kelly, 2001; Gremel, 2005).

Barred owls are generally more wary of humans and appear to be less responsive to our survey efforts than spotted owls. Most biases associated with our incidental data on barred owl occupancy, pair and reproductive status likely lead to underestimates of these parameters. For example, although we attempt to revisit every past activity center at a spotted owl site, more of those visits cover where the spotted owls were most recently located. Since current locations are often a result of spotted owls moving to areas of lower barred owl activity, less of our monitoring is devoted to the areas where barred owls are most abundant. Also, as barred owl densities have increased, it has become more difficult to discern the number of adjacent territories. Barred owls are not banded and we conservatively lump clusters of sightings within two kilometers of each other as one territory ("site") until we get simultaneous evidence of multiple pairs. Many barred owl sites with single occupancy were not visited frequently enough to determine pair status, or at the proper time to document reproduction.

In order to better document the presence of barred owls on an annual basis, we have begun to do a limited number of barred owl surveys using recorded barred owl calls. These were done at the end of the season after spotted owl surveys were completed with no response by either species at a site. We have also used programmable field recorders for the last three seasons to improve survey coverage in the areas of the study away from current spotted owl activity centers (see next section). Data from these surveys are tracked separately from the demographic monitoring data, so as not to bias comparisons of barred owl detections with previous years when these methods were not used.

We recorded barred owls on 58 separate occasions representing an estimated 41 barred owl territories during spotted owl surveys in 2012. To standardize for variable survey effort between years, the annual count of occupied barred owl sites is divided by the number of spotted owl site visits to derive an index of barred owl abundance (Fig. 4). The rate of increase in this index, calculated from the log of the slope from 1992-2012, was 11.6 % a year. Additional detections resulting from calling for barred owls (9 detections, 4 additional barred owl sites) and acoustic monitoring devices (13 detections, 5 additional barred owl sites) are not included in this total.



**Figure 4.** *Number of occupied barred owl sites detected, standardized by survey effort, Olympic National Park, 1992-2012. Excludes sites detected as a result of using barred owl calls, radio-telemetry, or acoustic monitoring devices.*

When including barred owls located by all methods, 26 barred owl pairs and 23 single barred owls were detected. This is not a complete count, only the number of barred owl territories detected in regions of the park covered by the spotted owl monitoring program. We documented reproduction by barred owls at 12 sites, fledging a minimum of 22 juveniles. An index of barred owl reproduction (the number of juveniles detected/occupied barred owl site) correlated significantly with annual rates of spotted owl fecundity from 1992-2006 at ONP (Spearman's  $\rho = 0.726$ ,  $p < 0.01$ ).

Hybridization between barred and spotted owls has been documented, but appears to be infrequent after the initial period of colonization (Hamer et al. 1994; Herter and Hicks, 2000; Kelly and Forsman, 2004). There are two known hybrids in the park, a male and a female, both paired with barred owls inhabiting former spotted owl activity centers. Neither of these banded birds were located this year. A hybrid juvenile was found and photographed in the Hoh shortly before it died this fall.

## Monitoring with Field Recorders

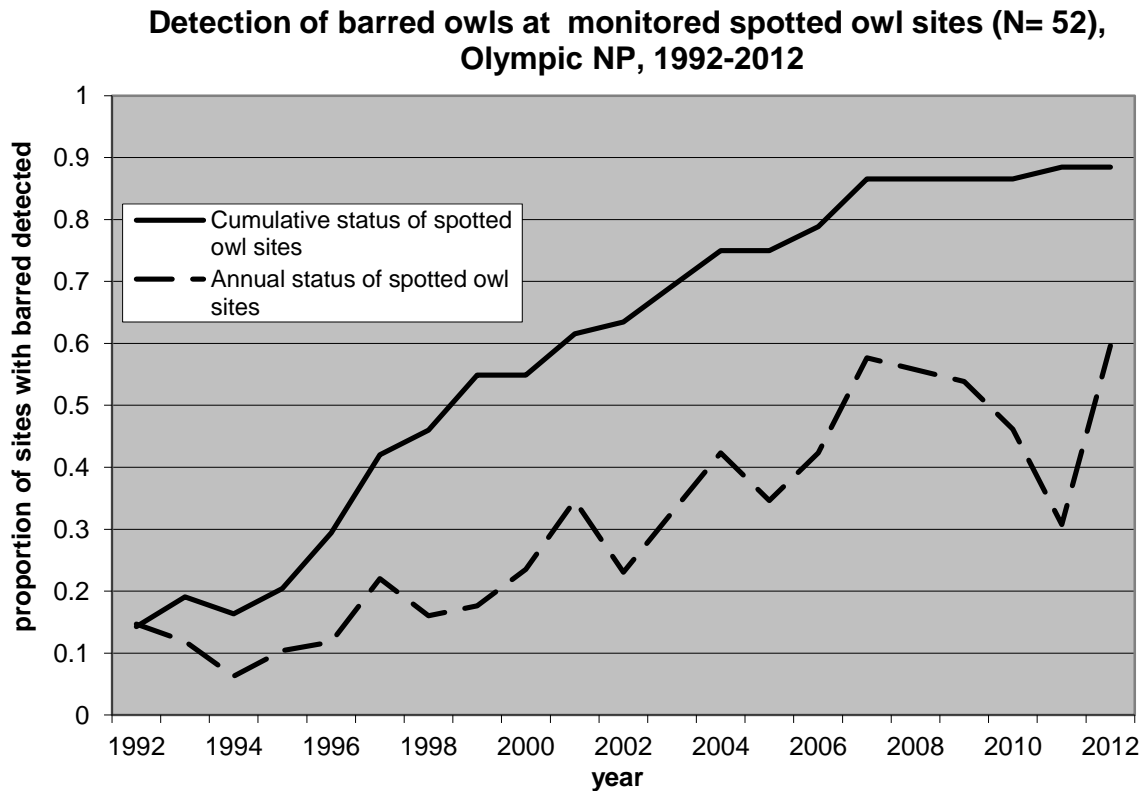
Since 2010 we have investigated the use of acoustic field recorders to determine presence or absence of barred and spotted owls at monitored sites. In 2010-2011 we deployed the recorders at sites with known occupancy by barred and spotted owls to estimate detection probabilities and develop protocols for analysis. We recorded over 2600 hours at 23 sites and analyzed 1600 hours, both by visually browsing spectrograms and by listening to recordings while working in the office. Using a sample unit of four hours beginning near sunset or ending near sunrise, we detected spotted owls on 21% of recordings at sites where they were resident and detected barred owls on 11% of recordings where they were resident. No spotted owls were detected at the barred owl sites, but several barred owls were heard at sites that recently supported spotted owls.

In 2012 we focused on documenting the presence of barred owls in spotted owl sites and continuing to build a dataset to estimate the probability of detecting barred owls when they are present. All samples were four hour recordings beginning either 10 minutes before sunset or 3 hours 50 minutes before sunrise, recorded in 1 channel at a sample rate of 16 khz. We visually browsed all recordings in the program Raven with 8 minute page intervals, noting the presence of all owl species and marbled murrelets. Length of time recorders were left out was based on the logistics of installing and removing the units during our demographic monitoring visits, and ranged from 4 to 34 sampling intervals.

We collected 1776 hours of field recordings from 29 locations; five most recently occupied by spotted owls and 24 most recently occupied by barred owls. At the five spotted owl centers, we detected spotted owls at one, barred owls at another, and had no detection at three locations on either the recorders or on monitoring visits. We detected barred owls at 15 of the 24 sites most recently occupied by that species. The mean probability of detecting a barred owl at these sites during a four hour recording was 0.19. This was an unweighted mean of 24 sites, and included 8 sites with known occupancy but no detections on the recorders. Marbled Murrelets (*Brachyramphus marmoratus*) were detected at 9 sites.

## Effects of Barred Owls on Spotted Owls

At ONP, rates of pair occupancy have declined at spotted owl sites following the first barred owl detection there. At sites where spotted owls have remained after barred owls were detected, they have both moved farther from their original location and shifted to higher elevations, relative to spotted owl sites without barred owls (Gremel, 2005).



**Figure 5. Proportion of monitored spotted owl sites (N=52) with barred owls detected, Olympic N.P., 1992-2012. The solid line is the proportion of sites where barred owls have been detected in any year, and the broken line is the proportion of sites where barred owls were detected in each year during spotted owl monitoring visits.**

In 2012 we detected barred owls during monitoring activities at 31 spotted owl sites, defined here as the area within 800m of the activity centers occupied between 1990 and 2012 (Fig. 5). Barred owls were detected at an additional 11 spotted owl sites from field recorders or barred owl surveys. Combining all survey methods, barred owls were found at 81% of monitored spotted owl sites this year.

Four of the 23 occupied spotted owl activity centers, including two single owls and two non-nesting pairs, were located within 800m of a barred owl detection this year. No spotted owl nests were found within 800 meters of a barred owl detected this year, and six of seven spotted owl nests were located greater than 800 m from a barred owl detection in any year.

We are unsure of the causes of the decline in annual detections of barred owls over the last several years, but consistently find that when we focus surveys using barred owl calls, night-time visits or field recorders on sites where barred owls were found in the past, barred owls are still present. Without sufficient resources to thoroughly survey all spotted owl sites for barred owls in this way, we believe that annual measures of barred owl detection are poor and

biased indicators of actual barred owl presence/absence at these sites. This year we made an effort to call and listen for longer periods of time in historic spotted owl activity centers. Continuous calling surveys have proven effective for searching large areas for spotted owls, but may miss barred owls which can be slower to respond during daytime surveys.

Data from ONP suggest that spotted owls are absent from areas occupied by barred owls rather than remaining and going undetected for many years. Although varying by year, there has been no time trend in annual spotted owl recapture probabilities, which have generally ranged between 0.6-0.8 (Anthony, et al., 2006), or per visit probability of detection at occupied sites, which has averaged 0.62 over 20 years of monitoring (ONP, unpub. data). While some data suggest that spotted owls are less vocal in the presence of barred owls (Crozier et al., 2006), we frequently detect owls on daytime visits whether or not they vocalize. Since we began recording the information in 2004, 44% of initial spotted owl detections have been visual, often as a result of owls flying in to surveyors, or surveyors investigating mobbing songbirds. We also locate spotted owl roosts by sign including pellets, whitewash, or feathers.

### Other Species

In addition to barred and spotted owls, we also record incidental responses by northern goshawks (*Accipiter gentilis*) and great-horned owls (*Bubo virginianus*). The number of occupied goshawk sites encountered during owl monitoring has ranged from 0-6 per year. This year we encountered goshawks at nine sites. Two of these were pairs and one pair was seen with a juvenile. We detected a great-horned owl at one site.

## **COOPERATIVE EFFORTS**

### 2009 Spotted Owl Demography Workshop

We participated in the northern spotted owl demographic workshop, held January 2009 in Corvallis, OR. This was the fifth analysis to examine data from the spotted owl demography studies being conducted across the species range. Data from federal lands on the Olympic Peninsula (ONP and Olympic National Forest combined) were analyzed along with those from 10 other demographic studies to estimate age-specific rates of fecundity, survival and population trends across the range of the northern spotted owl. Results of this analysis were published in 2011 (Forsman, et al., 2011).

The rate of fecundity on the Olympic Demographic Study Area was stable and best explained by the tendency of spotted owls to reproduce in alternate years here (even/odd year effect). Annual apparent survival of territorial females declined over time at Olympic, and at nine of

the ten other studies, with declines most pronounced for many areas in recent years. The steepest declines in apparent survival were on the three studies in Washington State.

Range-wide, the decline in numbers of territorial northern spotted owls was estimated to be 2.9% a year. Point estimates for all study indicated declining populations, and there was evidence for a statistically significant population decline at seven of eleven studies, including Olympic. The estimate of decline in the Olympic demographic study was 4.3% a year. Overall, it appeared that spotted owl populations in Washington were faring worse than those in Oregon and California.

#### Northern Spotted Owl Presence/Absence Monitoring

The need for a more extensive survey method, designed to track both population trends and changes in distribution, is a priority for the NPS. Beginning in 2005, these surveys were implemented as part of a long-term landbird monitoring program. Crews from The Institute for Bird Populations survey randomly located 1.8 km-long transects, using protocols developed for a spotted owl inventory conducted at ONP in the early 1990s. After conducting point counts for landbirds at stations along these transects, surveyors call for spotted owls at five stations located 400 meters apart. Stations are called for 10 minutes and all stations in forested habitat are called, regardless of elevation. These surveys are providing an inexpensive test of the feasibility and statistical power of implementing a larger scale presence/absence survey.

Overall response rates by spotted owls have been quite low (Appendix 2). No spotted owls were detected by IBP crews this year. Between 2005-2012, surveys in these parks resulted in 6 detections of spotted owls and 29 detections of barred owls on 413 transects.

#### Other Interagency Activities and Outreach

- Presented talk on the management of barred and spotted owls in Olympic National Park to the Vashon Audubon society, March 21, 2012.
- Provided records of all field visits and annual site summary information to the Washington Department of Fish and Wildlife for a state-wide spotted owl database.

## **BUDGET**

All funding was provided by the NPS through the Regional Ecosystem Office of the Northwest Forest Plan. Funding for spotted owl monitoring was provided at the level of \$141,600 in FY 2012. An additional \$5000 was provided to support NPS participation in northern spotted owl recovery planning.

## ACKNOWLEDGMENTS

The project is only possible due to the hard work, skill and dedication of the field crew. Declining spotted owl numbers require an increasing number of daylong no response searches in roadless wilderness and often difficult weather conditions. J.S. Busiek, E.R. Burke, L.H. Graham, C.R. Grattan, S.A. Gremel, K.M. Harrigan, J.D. Herndon, T.J. Kay, E.R. Kohler and M.E. Salvadale performed the fieldwork in 2012. Patti Happe, ONP Wildlife Branch Chief, provided overall project supervision and administration, T.J. Kay and L.H. Graham assisted with coordination and supervision of the field work, and R.A. Hoffman and K.F. Beirne provided GIS support and analysis. Liz Kelly of the USFWS generously provided the program used to map barred owl locations relative to spotted owl sites.

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## APPENDIX 1- Nest Success

**Nesting status and success rate of female spotted owls of all age classes, at monitored sites in Olympic National Park, 1992-2012.**

	Non-nesting	Nesting	Unknown nest status	Total females	Proportion nest status known	Proportion females nesting	Nest success <sup>1</sup>
1992	1	15	7	23	0.70	0.94	0.93
1993	16		5	21	0.76	0	*
1994	3	24	7	34	0.79	0.89	0.92
1995	15		6	21	0.71	0	*
1996	5	28	3	36	0.92	0.85	0.92
1997	15	8	6	29	0.79	0.35	0.75
1998	1	24	5	30	0.83	0.96	0.91
1999	9		5	14	0.64	0	*
2000	17	10	4	31	0.87	0.37	0.56
2001	16	8	4	28	0.86	0.33	1.00
2002	3	27		30	1.00	0.90	0.92
2003	23		3	26	0.88	0	*
2004	2	22	4	28	0.86	0.92	0.95
2005	20	1	3	24	0.88	0.05	1.00
2006	1	17	2	20	0.90	0.94	0.94
2007	13		1	14	0.93	0	*
2008	1	16	2	19	0.89	0.94	0.94
2009	8		2	10	0.80	0	*
2010	3	14	1	18	0.94	0.82	0.93
2011	5		1	6	0.83	0	*
2012	2	7	2	11	0.82	0.78	1.00
Total <sup>2</sup>	179	221	73	473	0.84	0.48	0.91

<sup>1</sup> Proportion of nest attempts that result in at least one fledgling, calculated on nests with known outcomes

<sup>2</sup> Where totals are calculated on proportions, they are the unweighted averages of the annual means

## APPENDIX 2- IBP Owl Survey Results

**Results of presence/absence owl surveys performed by The Institute for Bird Populations' landbird monitoring crews. This includes barred and spotted owls detected at or associated with owl calling stations, as well as incidental detections outside of formal survey or while conducting point counts. Multiple owls at a point are recorded as a single detection.**

Year	National Park	Transects Called	Stations Called	Barred Owl Detections			Spotted Owl Detections		
				At Stations	Between Stations	Incidental	At Stations	Between Stations	Incidental
2005	Mt. Rainier	9	40	0	1	0	0	0	0
	N. Cascades	11	53	0	0	0	0	0	0
	Olympic	8	34	0	0	0	0	0	1
2006	N. Cascades	12	57	1	1	0	1	0	0
	Olympic	10	44	3	0	0	1	0	0
2007	Mt. Rainier	19	114	0	1	1	0	0	0
	N. Cascades	22	104	2	1	2	0	0	0
	Olympic	21	95	0	0	0	0	0	0
2008	Mt. Rainier	20	94	1	1	0	0	0	0
	N. Cascades	20	96	3	0	0	0	0	0
	Olympic	21	95	0	0	3	1	1	0
2009	Mt. Rainier	16	69	1	0	0	0	0	0
	N. Cascades	23	97	0	0	0	0	0	0
	Olympic	22	91	2	0	2	1	0	1
2010	Mt. Rainier	17	74	1	0	0	0	0	0
	N. Cascades	19	80	1	0	0	0	0	0
	Olympic	22	95	0	0	1	1	0	0
2011	Mt. Rainier	12	50	1	1	1	0	0	0
	N. Cascades	21	101	2	0	1	0	0	0
	Olympic	20	93	0	0	4	0	0	0
2012	Mt. Rainier	20	99	1	0	0	0	0	0
	N. Cascades	24	114	4	0	3	0	0	0
	Olympic	24	114	0	0	2	0	0	0